

TO: Dr. H. Wakeham ✓

DATE: July 25, 1966

FROM: F. E. Resnik

SUBJECT: FTC Determination of TPM and Nicotine

The purpose of this memo is to comment on the proposed FTC determination of TPM and to supplement Mr. T. Budne's memo of July 13, 1966.

#### TPM MEASUREMENT

##### Sampling

FTC must decide if its objective is to analyze the product that the consumer is getting or the product that the manufacturer is producing. These different objectives would require a different mode of sampling; thus, the FTC objective must be stated before a sampling procedure can be recommended. Mr. Budne's memo, in addition to memos by Dr. H. Arkin (March 18, 1958) and Dr. C. V. Mace (March 28, 1958), cover sampling procedures in detail.

##### TPM Composition

TPM accounts for only 8% of the composition of cigarette smoke. In fact, over 90% of cigarette smoke is air, carbon dioxide, carbon monoxide, and water. These components are in the gaseous phase, which is not measured by the Ogg method. (Table I)

As pointed out in Mr. Budne's memo, TPM is not a chemical entity but defined by the measuring procedure itself. TPM is a mixture of many chemical compounds and the individual smoke components vary both quantitatively and qualitatively from brand to brand. The composition of the TPM may be more important than the weight of TPM.

##### Water in TPM

The water content of TPM is about 10% with a range of from 8 to 13 % for commercial brands (see Table II). This means that the TPM values contain approximately 1 to 3 mg of water per cigarette.

The water content of TPM is about 25% of the total water content of whole smoke while the remaining 75% passes through the Cambridge pad as gaseous phase.

The TPM, as determined by the Ogg procedure, includes water, thus the amount of TPM can be varied by changing the water content of the filler or filter or by selectively removing the water via filtration.

If the decision is made to report TPM on a water-free basis, where do we stop? Why not subtract humectants, (glycerine and propylene glycol), menthol, and filter additives (triacetin), etc. from the smoke?

#### Monitor

Mr. Budne's memo covered the use of a monitor cigarette to maintain uniform smoking data with time. To the best of our knowledge, Philip Morris is the only company using a cigarette monitor with the exception of the U. S. Testing Company, which we set-up during our contract work with them. Dr. C. Keith of Celanese and Mr. G. Touey of Tennessee Eastman, stated that they do not use a monitor nor are they aware of the use of a monitor by any of our competitors.

#### Carton to Carton TPM Variation

In the C.I. Program, the average between carton TPM variation is 1.5 mg/cigt for all brands. However, in some brands, the between carton variation is as much as 4 to 5 mg/cigt. The magnitude of this TPM variation between cartons points out the necessity of obtaining a representative sample over many cartons.

#### THE SMOKING PROCEDURE

##### Conditioning of Cigarettes

The Ogg procedure calls for conditioning cigarettes at 75°F and 60% RH for 24 hours. If the cigarettes sampled are from various retail outlets and are extremely dry, the tendency will be for these cigarettes to equilibrate to lower moisture levels than fresh cigarettes. Equilibration of mentholated cigarettes results in a loss of filler menthol, which correlates with a slight reduction of menthol in TPM.

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### Weight Selection of Cigarettes

The Ogg paper states that 20 cigarettes should be selected within a  $\pm 20$  mg range of the average weight. In the case of commercial cigarettes sampled through our C.I. Program, this selection includes less than 50% of the sample. Thus 50% of the cigarettes are not represented in the TPM value, if this procedure is followed (see Figure I). The weight selection is so narrow that even under the most ideal cigarette making conditions used for our monitor cigarettes, only 50% of the cigarettes fall within these weight specifications. TPM level is a function of weight, as the weight increases the TPM increases.

### Smoking Environment

The procedure calls for smoking the cigarettes under the same environment (75°F and 60% RH) as that used for cigarette conditioning. The major problem in this area is the air flow around the cigarette. As the air flow around the cigarette is increased, the TPM is lowered. Although the Ogg procedure calls for smoking in the absence of drafts, this is not very definitive. Laboratories are constantly subjected to changing drafts and this aspect of the smoking can lead to variability and TPM level shifts as discussed in Mr. Budne's memo.

### Butt Length

The butt length to which a cigarette is smoked affects the TPM and nicotine deliveries, particularly, as described in the Ogg method which calls for a subjective response by the operator. The operator must make a decision when the 30 mm butt mark is reached to terminate the smoking. Since this decision must be made at the point at which the cigarette is delivering the highest concentration of TPM per puff, an imbalance of "overs" and "unders" leads to variability in smoke delivery. This subjective decision

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can be eliminated by using the procedure we developed involving a string-solenoid cut-off. A plot of TPM vs butt length illustrates the possible magnitude of this change in delivery (Figure II).

#### Tipping Paper

Four cigarette brands (Carlton, Life, Duke, and True) are presently on the market with tipping papers of 30 mm in length. The Ogg method does not cover situations which might require smoking to butt lengths that are longer than 30 mm.

In the past, Reader's Digest reported on cigarettes smoked to a butt length 2 mm greater than the tipping paper, thus the above mentioned cigarettes would be smoked by them to a 32 mm butt.

FER:rab

cc: H. Cullman  
C. H. Goldsmith  
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*J E R. k*

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TABLE I\*

Material Balance of Cigarette Smoke, 85 mm Unfiltered Cigarettes -  
10 Puffs of 38.9 ml Volume, 30 mm Butt Length

Material	Weight, mg/cigt	Weight percent of total effluent
<u>TPM</u>		
Particulate Matter (inc. cond. H <sub>2</sub> O)	40.6	8.2
<u>Gas Phase</u>		
Nitrogen (67.2 volume %)	295.4	59.0
Oxygen (13.3 volume %)	66.8	13.4
Carbon Dioxide (9.8 volume %)	68.1	13.6
Carbon Monoxide (3.7 volume %)	16.2	3.2
Hydrogen (2.2 volume %)	0.7	0.1
Argon (0.8 volume %)	5.0	1.0
Methane (0.5 volume %)	1.3	0.3
Water Vapor (R. H. = 0.6)	5.8	1.2
C <sub>2</sub> - C <sub>6</sub> Hydrocarbons	2.5	0.5
Carbonyls	1.9	0.4
Hydrogen Cyanide	0.3	0.1
Other Known Gaseous Materials	1.0	0.2
Total	505.6	101.2
Measured Total Effluent	500	100

\*Reproduced from an article entitled, "Measurement of the Total Smoke Issuing from a Burning Cigarette," Tobacco Science, Vol. IX, p. 61, 1965, by C. H. Keith and P. G. Tesh, Liggett & Myers Tobacco Company.

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TABLE II

	<u>TPM,<sup>1</sup> mg/cigt</u>	<u>Water in TPM, %</u>	<u>Water in<sup>2</sup> TPM, mg/cigt</u>	<u>TPM less Water mg/cigt</u>	<u>TPM Less Water &amp; Nicotine mg/cigt</u>
<u>KING FILTER - PLAIN</u>					
Duke	12.8	9.9	1.3	11.5	11.1
Life	14.4	9.9	1.4	13.0	12.1
True	17.5	12.9	2.3	15.2	14.4
Kent	19.1	10.1	1.9	17.2	16.2
PARLIAMENT	20.0	10.6	2.1	17.9	16.8
Winston	22.4	9.2	2.1	20.3	19.1
Viceroy	23.0	8.9	2.0	21.0	19.6
MARLBORO	23.4	9.6	2.2	21.2	19.9
Waterford	25.1	9.4	2.4	22.7	21.4
<u>KING FILTER - CHARCOAL</u>					
Carlton	11.0	7.5	0.8	9.7	9.0
Tareyton	19.4	10.0	1.9	17.5	16.5
Tempo	21.4	9.3	2.0	19.3	18.0
P. M. FILTER	22.0	10.8	2.4	19.4	18.1
Lark	23.7	12.6	3.0	20.7	19.6
<u>KING FILTER - MENTHOL</u>					
Salem	22.0	9.5	2.1	19.9	18.6
MARLBORO	23.8	10.1	2.4	21.4	20.2
Kool	25.1	10.0	2.5	22.6	21.0

<sup>1</sup>Data from C.I. Report 7-66

<sup>2</sup>Calculated using C.I. TPM data based on the percent water in TPM as analyzed.

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Cigarette Weight, gms

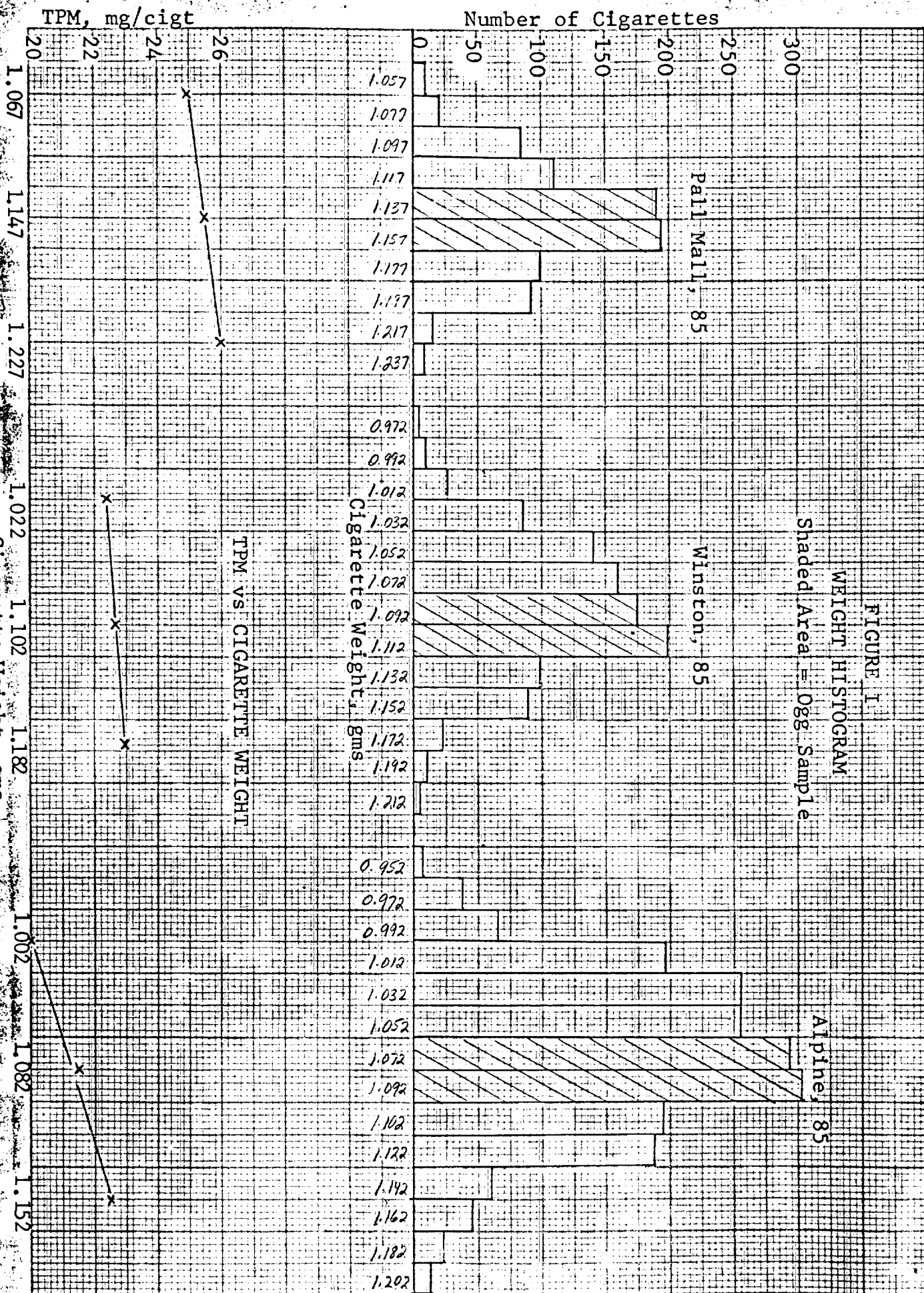
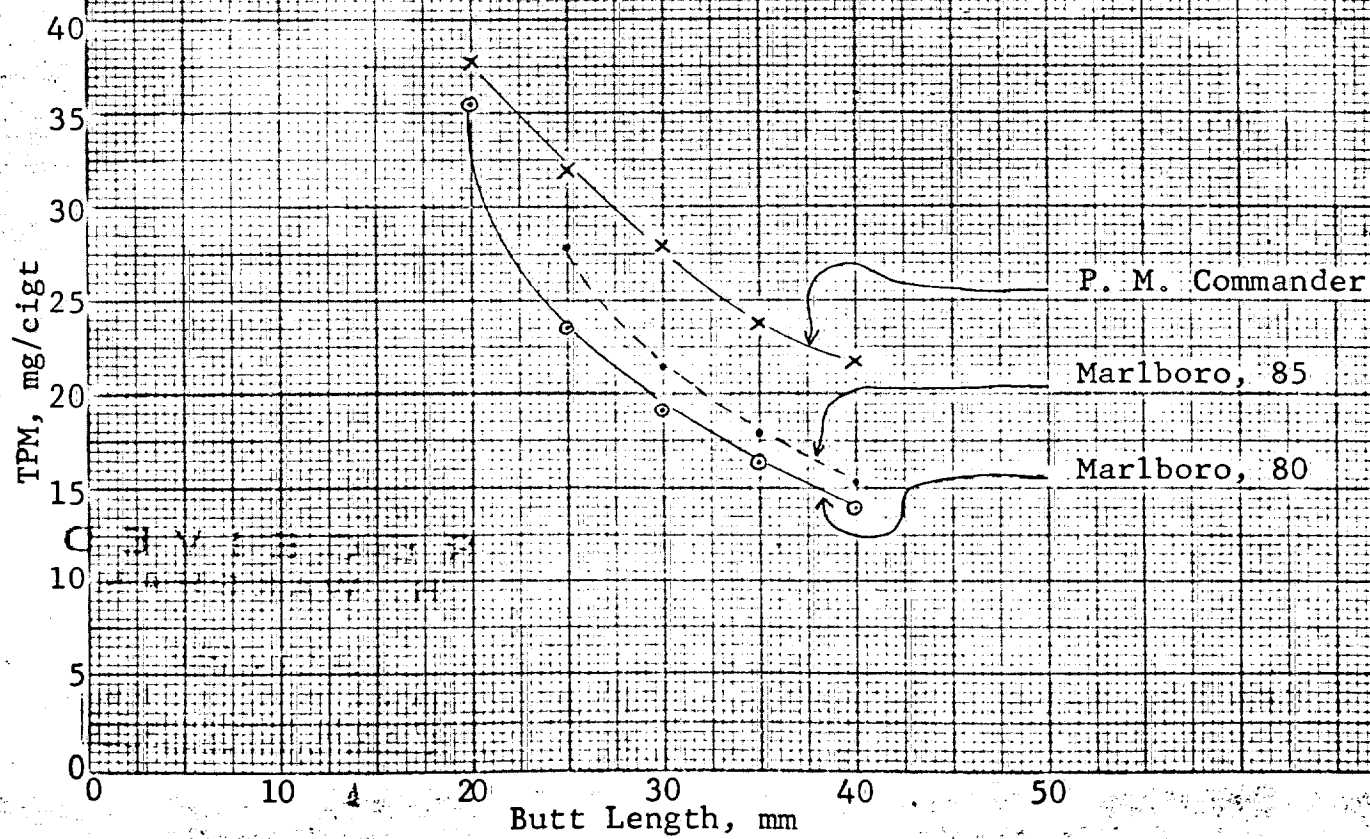


FIGURE II

TPM vs. BUTT LENGTH



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H. WAKEHAM

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A.M.				P.M.							
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